Electronic Sensor

Surface Acoustic Wave/Gas Chromatography System for Trace Vapor Analysis

Technology Need:

Field personnel are currently hampered in identifying hazardous materials and monitoring waste site cleanups. Current methods use mobile laboratories with highly skilled technicians and chemists at the site or obtain samples and transport them to a regional laboratory for analysis. Either option is time consuming and expensive. A highly sensitive, rugged, portable vapor detector is needed for identifying hazardous materials.

Technology Description:

Electronic Sensor Technology (EST), a Division of Amerasia Technology, Inc., has developed a portable, highly sensitive, rugged, vapor detector system (Model 4100 Trace Vapor Analyzer) which provides for low-cost, accurate vapor detection and analysis. Its purpose is to provide a low cost instrument for identifying hazardous materials and for monitoring Department of Energy (DOE) waste site cleanups throughout the United States.

The Model 4100 (shown in Figure 1) utilizes a patented piezoelectric Surface Acoustic Wave (SAW) resonator device and capillary gas chromatography. The result is a portable system that provides high detection specificity, selectivity, and sensitivity. The SAW resonate sensor has excellent recovery characteristics and provides a trace analysis in less than 30 seconds.

The Model 4100 consists of a portable gas chromatograph (GC) a SAW sensor, and a dynamic particle/vapor capture head. The three components are shock mounted in a rugged field-portable fiberglass carrying case. The Model 4100 captures the sample in a cyrogenic focus chamber. The chamber deposits the sample upon the SAW sensor. The SAW sensor determines the change in its mass density and reports it to the database maintained in a laptop computer.

Figure 1. Portable SAW/GC Instrument

The Model 4100 database identifies the suspect sample through an analysis of the numerous chemical signatures it has previously identified and recorded. The analysis is then displayed with both visual and numerical data results.

The Model 4100 has the following specifications:

•Size/weight :14 by 20 by 10 inches/35 lb. (15.9 kg.)
•Analysis Time: 5 seconds to 2 minutes per sample
•Price: $30,000 to $50,000 (GSA pricing available)
•Sensitivity: 50 picograms, or parts per trillion
•Dynamic range of more than 8 orders of magnitude
•Eight hour operation with a refill helium gas carrier

Minimum detection limits are listed on the following page for selected compounds. This list is not inclusive of all of the substances eligible for analysis:

Constituent	Detection Limit (ppb)
Trichloroethylene	10
Tetrachloroethylene	3
Carbon Tetrachloride	70
Chloroform	65
Dichloromethane	600
1,2-Dichloroethane	370
1,1,1-Trichloroethane	3,570
cis-Dichloroethylene	110
1,1,2,2-Tetrachloroethane	1.3
Trichlorofluoromethane	25,640
Benzene	45
Toluene	4.5
Ethylbenzene	2.0
O-Xylene	2.0
Gasoline	10-100
Diesel Fuel	1

Benefits:

<Cost effective, rapid analysis with high sensitivity.

<Portable device can be configured for stand alone uses or integrated with other systems.

<Can be used in water, soil, vapor and particle mediums.

Applications of this technology include:

<Environmental Monitoring: field screening/analysis during remediation activities, air monitoring for occupational safety and health, monitoring chemical processes, and monitoring of fugitive emissions.

<Law Enforcement/Military: contraband, drugs, explosives, lethal chemicals, and toxic gas warfare.

<Industrial Monitoring: stack emissions, dioxins, particle chemical processes, incineration, and continuous emission monitoring (CEM), toxic gas, and combustibles.

Status and Accomplishments:

This project was completed in September 1996. The technology was demonstrated and/or deployed several DOE sites including Hanford, Savannah River Site (SRS), Lawrence Berkely National Laboratory (LBNL), and the Idaho National Engineering and Environmental Laboratory (INEEL). The testing at LBNL and INEEL involved analyzing soil gas and groundwater samples, while the work at Hanford analyzed head space samples from waste tanks. EST markets the Model 4100 Trace Vapor Analyzer for multiple applications under the name zNose™. Although initially developed for environmental applications, the technology's primary market is currently in food and beverage quality control.

Units have been sold to the INEEL and Lawrence Livermore National Laboratory (LLNL), as well as organizations in Japan, China, Taiwan, and Malaysia.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 282
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For more information on the SAW/GC technology visit the EST website at http://www.estcal.com

An Innovative Technology Summary Report is available for this technology at http://apps.em.doe.gov/ost/pubs/itsrs/itsr282.pdf